TRW SPACE TECHNOLOGY LABORATORIES
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20 January 1965

9270.2-123

National Aeronautics and Space Administration
Goddard Space Flight Center
Glen Dale Road
Greenbelt, Maryland

Attention: Mr. M. Schach
Code 633

Subject: Monthly Progress Report
Period Ending 1 January 1965
Contract NAS5-3805
Report No. 4161-6009-SU-000

I. Progress in This Report Period

A low energy proton experiment was performed in this report period utilizing the STL 2 Mev proton Van de Graaff. Although the data are still in the process of being analyzed, several points of interest are evident in the preliminary results. The degradation rate, i.e., the slope of the short circuit current density versus log of the integrated exposure, becomes steeper at the lower proton energies. Degradation slopes as high as 50 per cent per decade are observed in some cases compared with the normally observed 20 to 25 per cent per decade slopes under conditions of penetrating radiation and uniform damage. The increased slope observed under low energy proton bombardment is due principally to the localized region of damage near the junction since low energy protons will not penetrate to a depth of a diffusion length. In addition, at the lower proton energies the open circuit voltage degradation becomes more important and in fact actually exceeds the short circuit current degradation at proton energies below approximately 300 to 400 kev. Associated with the increased degradation rate of the open circuit voltage at the lower proton energies is a marked decrease in the form factor of the I-V characteristic. This effect is apparently due to the large accumulation of defects in the top layer of the cell which changes the resistivity sufficiently to increase the series resistance of the device. As a result of these degradations in open circuit voltage and form factor, the maximum power degradation rate of the cell will decrease far more rapidly relative to the short circuit current degradation under low energy proton bombardment than is normally observed with penetrating radiation. For these reasons complete

degradation characteristics of the low energy proton bombarded solar cells will be obtained on a sun simulator in order that the data be of direct engineering use since extrapolations from tungsten illumination data are not valid for the non-uniform damage case.

Several difficulties were encountered in the conduct of the experiment which necessitated early shut-down for repair. Although data were obtained at energies ranging from 0.2 to 1.65 Mev, higher energies were not available due to accelerator difficulties which gradually deteriorated to the point where further experimentation was not possible. In addition there were indications in the data that under certain conditions of operation, scattered particles of unknown origin were present in the irradiating beam in quantities sufficiently significant to invalidate the results. For these reasons, the experiment was stopped and repair and modifications on both the accelerator and the irradiating chamber and spectrometer were initiated. It is anticipated that considerably more data will be obtained when these repairs and modifications are completed in approximately six to eight weeks.

In the last report period agreement was reached between NASA personnel and STL personnel on the importance of a no-cost time extension of the contract to account for the delays encountered in conducting a low energy proton experiment and to provide additional time to obtain more high energy electron data. On this basis, re-orientation of the program was initiated in order to schedule the necessary accelerator facilities and conduct the experiments. For these reasons efforts on a final contract report as required by the original contract were not initiated but instead efforts were concentrated on the performance of the low energy proton experiment which had been delayed due to equipment malfunctions and schedule problems. This re-direction will continue in the next report period in anticipation of formal contractual acceptance of the discussed contract time extension.

II. Anticipated Activities During the Next Report Period

Specimens have been ordered and planning is underway for the performance of additional high energy electron radiation effects experiments in the 1 to 4 Mev region. In addition, repairs and modifications of the proton accelerator and irradiation apparatus will be conducted in preparation for further low energy proton experiments.

III. Manpower Expended in This Report Period

MANPOWER EXPENDITURES

NAS5-3805

Period 6 December 1964 to 2 January 1965

	Total
J. R. Carter	168
R. G. Downing	26
Total	194

Respectfully submitted,

R. G. Downing
Project Manager

Approved:

J. M. Denney, Director
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RGD:rct